Example-based NPR

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Designing styles

Procedural

Hand-drawn

Example-based rendering

- Design *by example*
- One mechanism, many styles

Problems

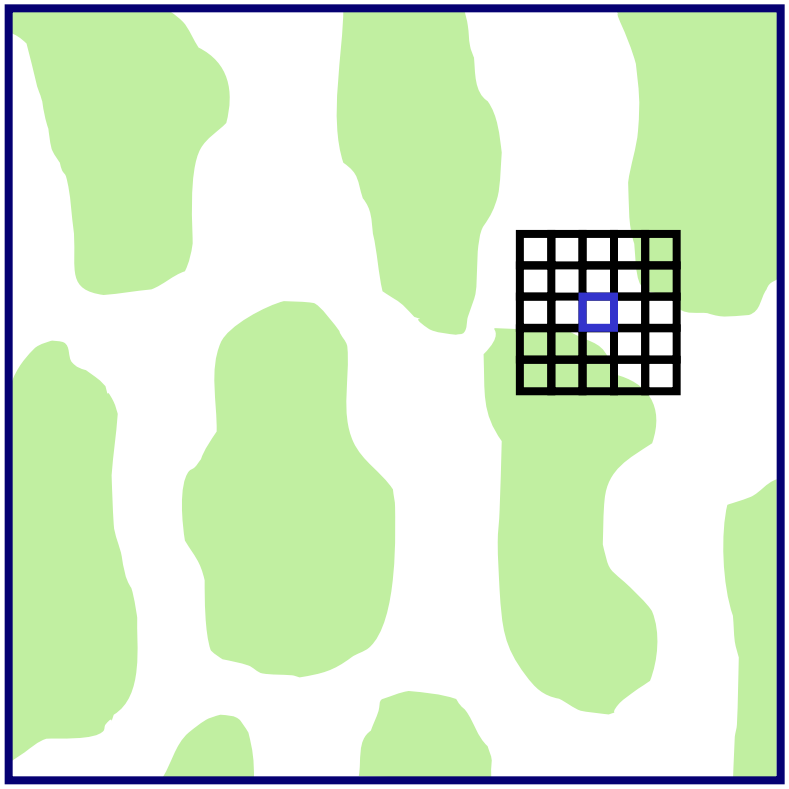
- No unique model
- What aspects of the examples are important?

Outline

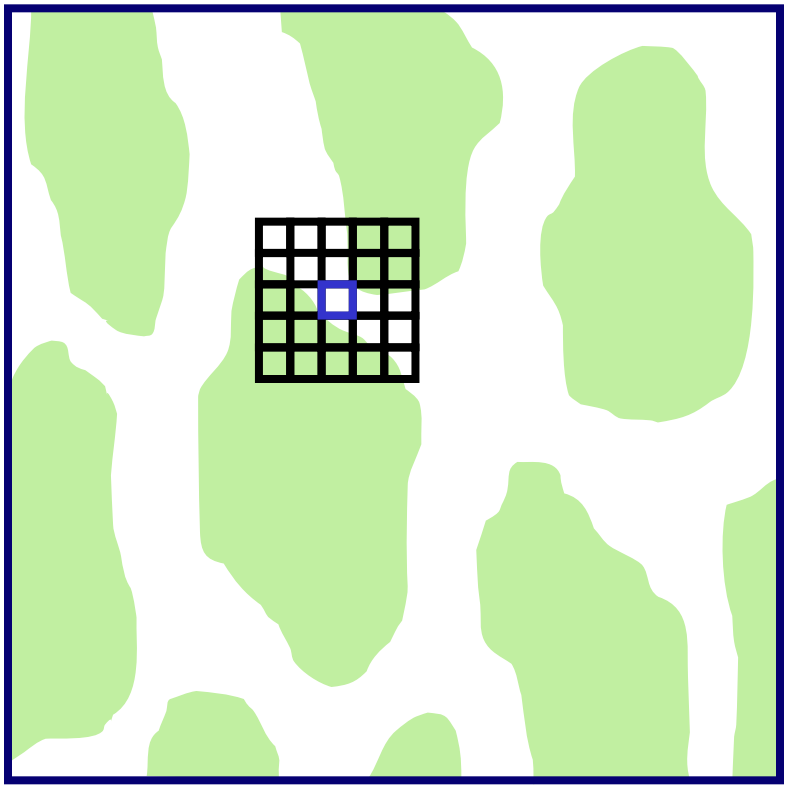
- Image texture synthesis
- Image processing
- Strokes
- A hybrid algorithm

Texture synthesis

- Goal: Match image statistics

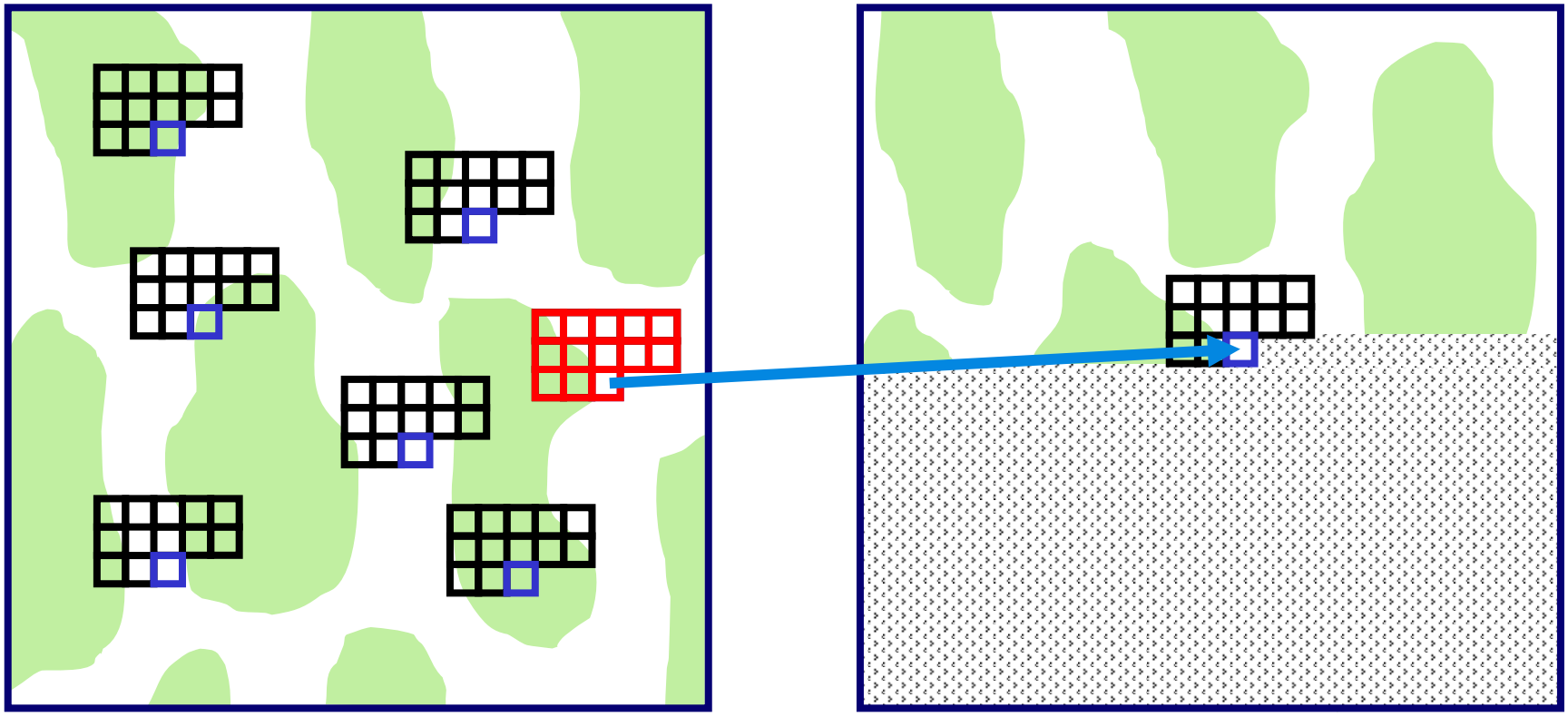


Input texture



Output texture

Texture synthesis



Input texture

Output texture

Synthesis result

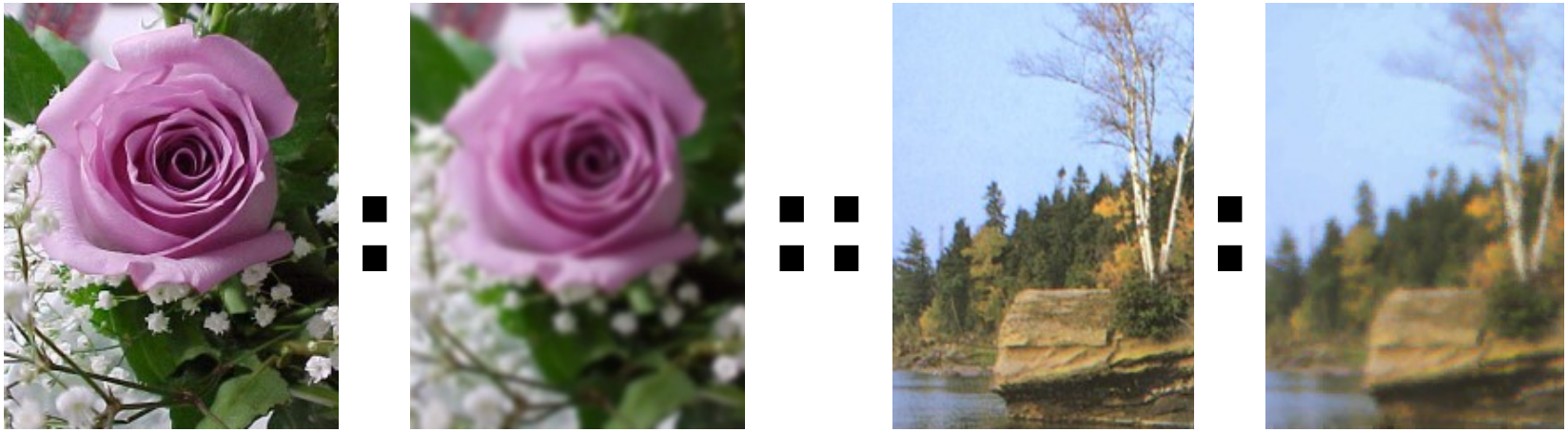
Input texture

Output texture

Texture synthesis

- Nearest neighbors
  - Efros and Leung, ICCV 99
  - Wei and Levoy, SIGGRAPH 00
- Coherence
  - Ashikhmin, I3DG 01
  - Hertzmann et al, SIGGRAPH 01
- Tiles
  - Efros and Freeman, SIGGRAPH 01
  - Liang et al., TOG 01

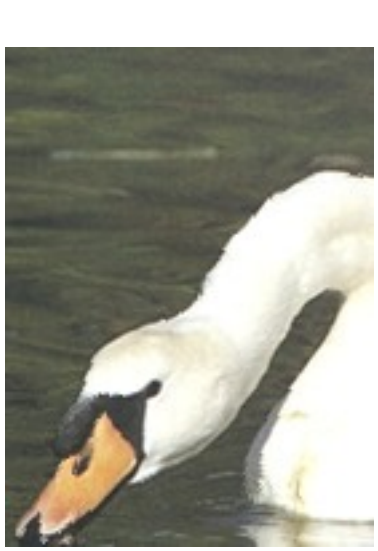
Image analogies



A **A’** **B** **B’**

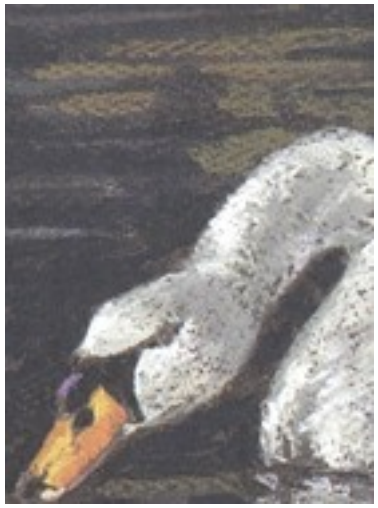
Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

Image analogies



A

:



A’

::

B

:

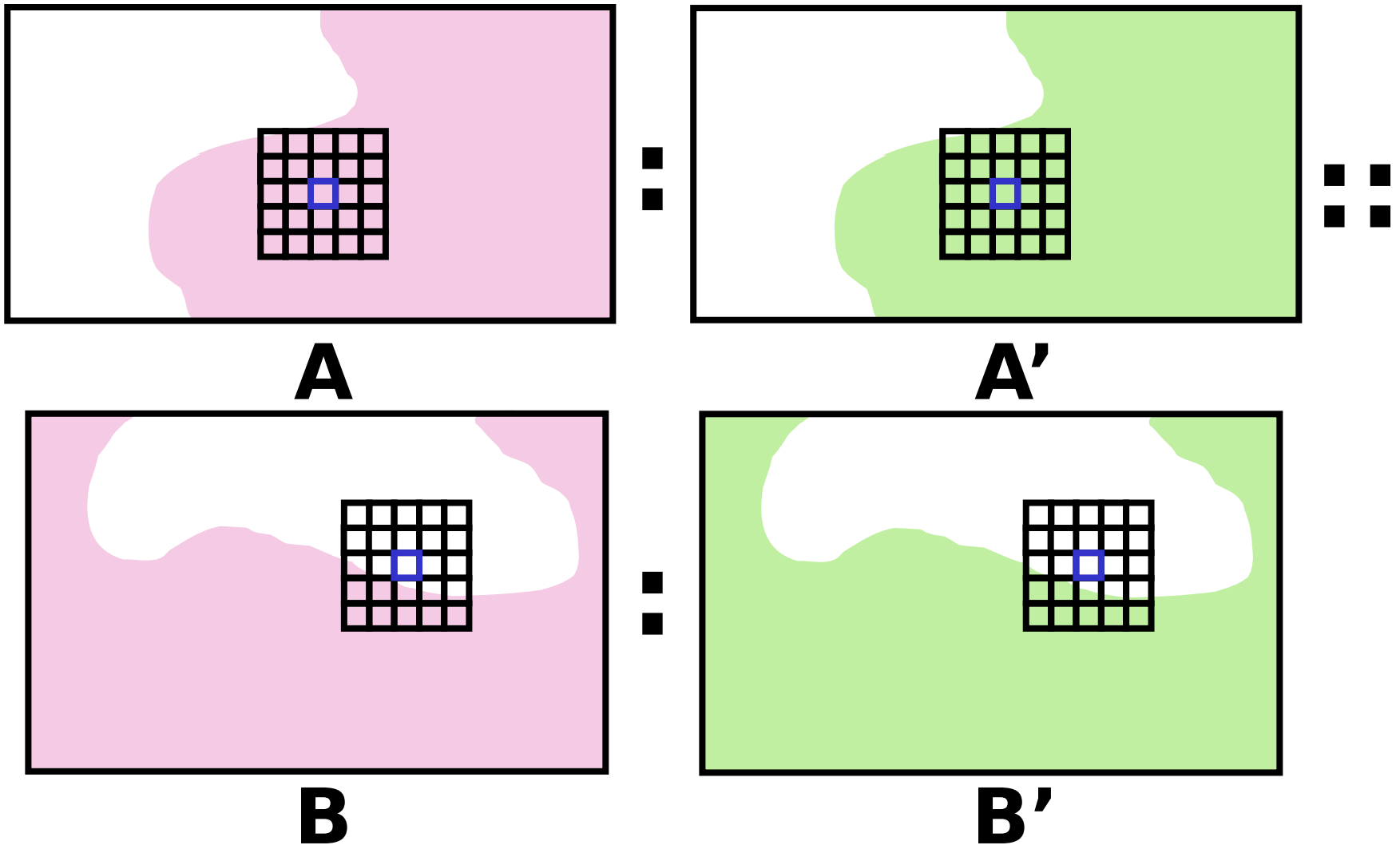
?

B’

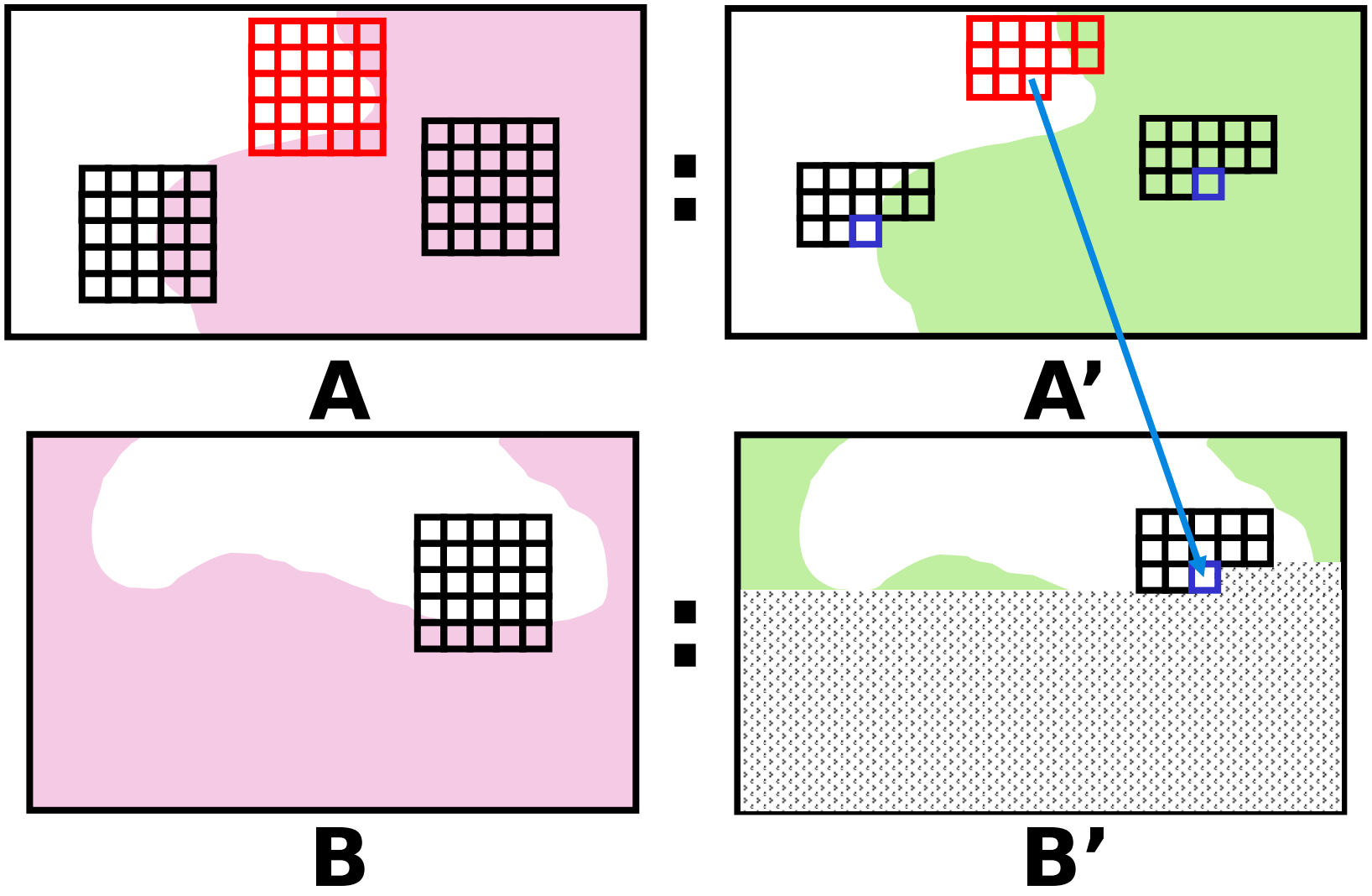
Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

Image analogies

- Goal: Match *joint* image statistics



Analogies synthesis



Feature vectors

Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

Feature vectors

Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

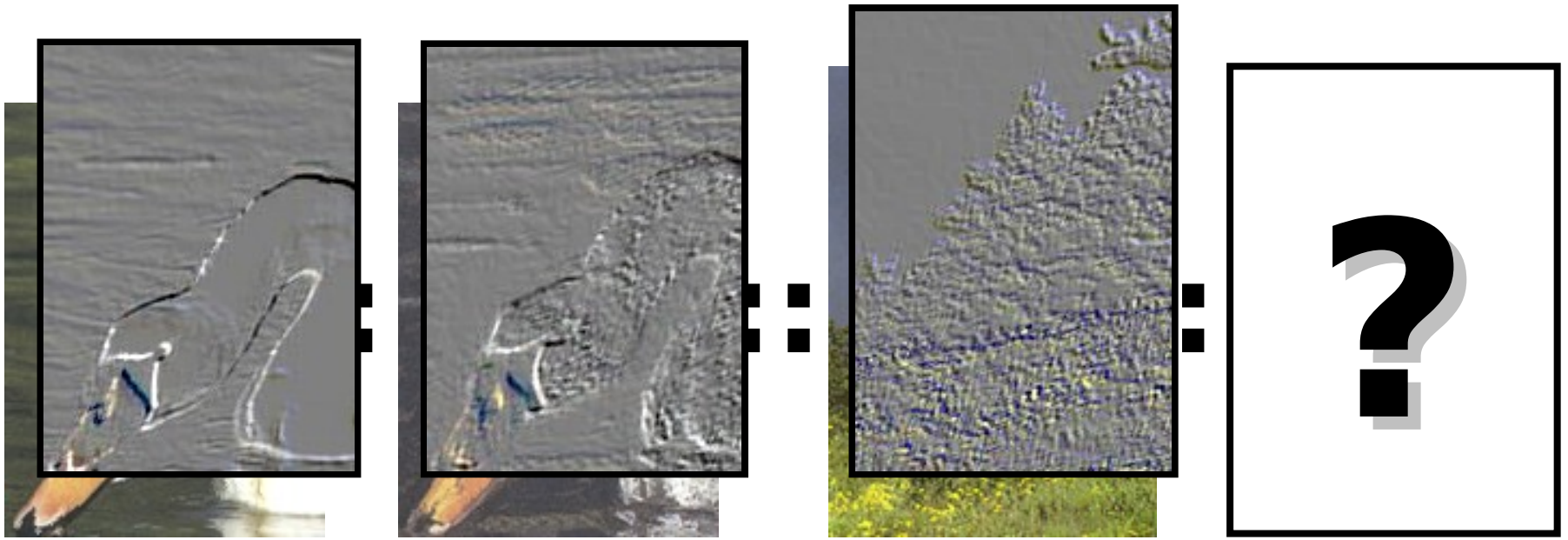
Color

- Combine new luminance with source color B

B’ (Y) **B** (IQ) **B’** (Final)

Hertzmann et al., SIGGRAPH 01

Feature vectors



Hertzmann et al., SIGGRAPH 01

Pen-and-ink

A

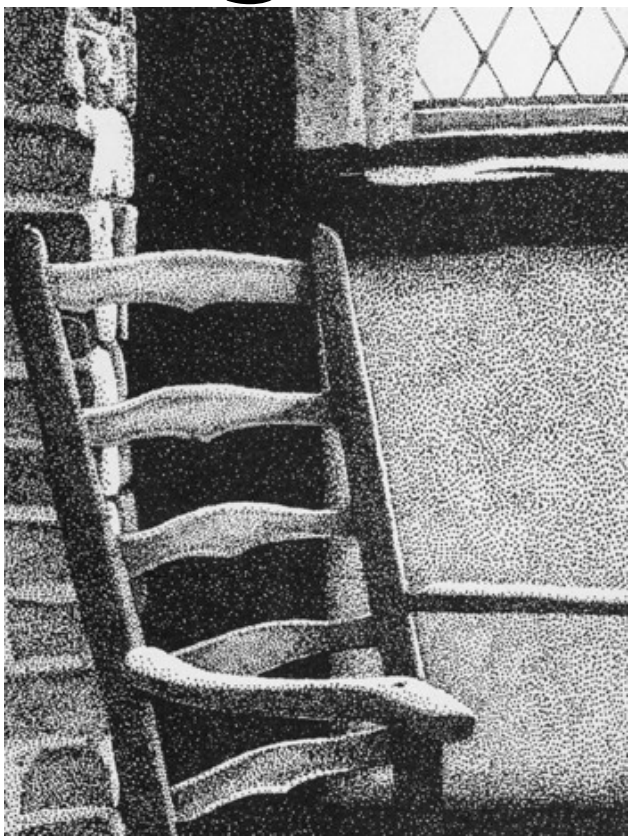
A’

B

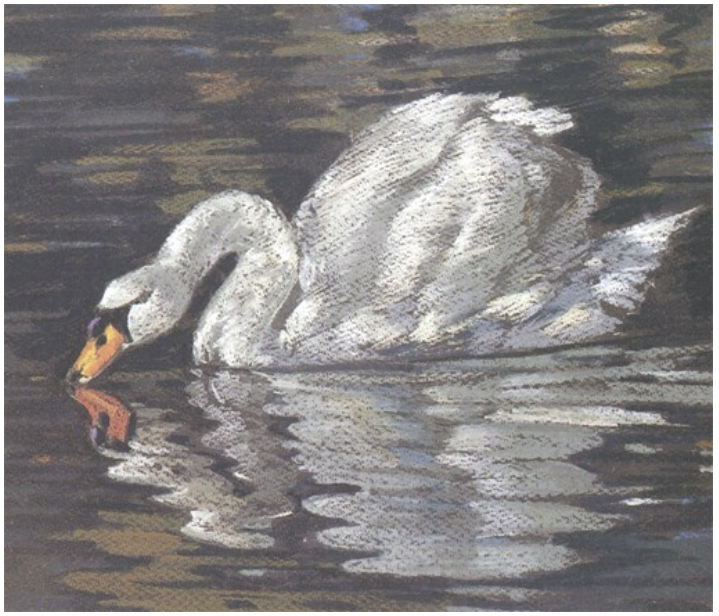
B’

Stippling

:

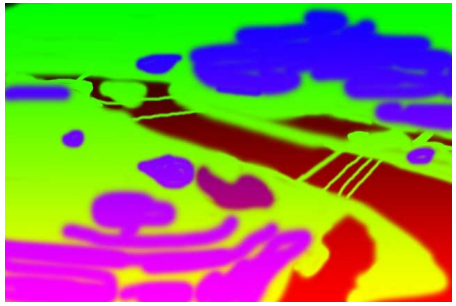


A **A’**



From *Starry Night over the Rhône*, by Vincent Van Gogh , 1888

Texture-by-numbers

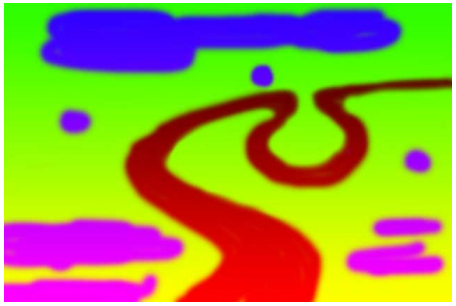


:

A

A’

Texture-by-numbers

::  :

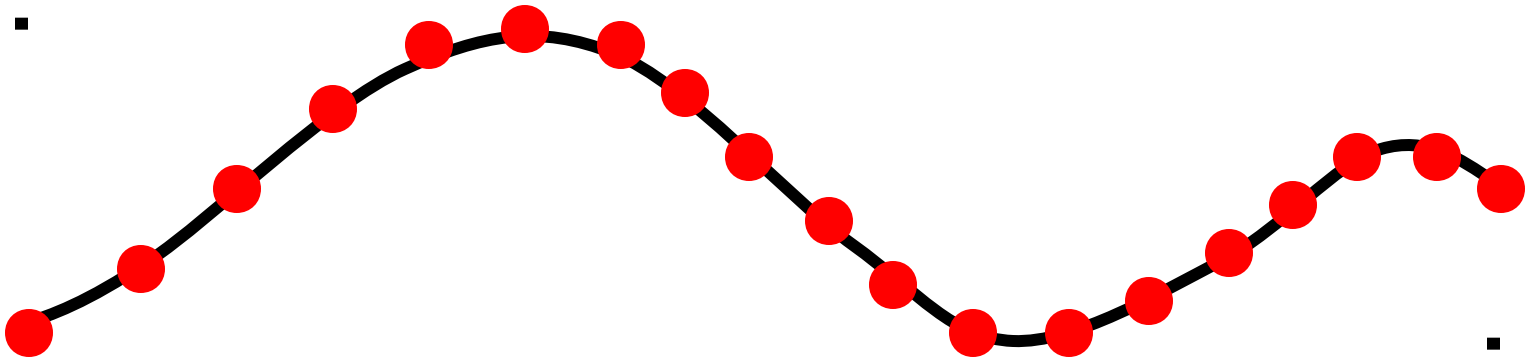
B

B’

Strokes

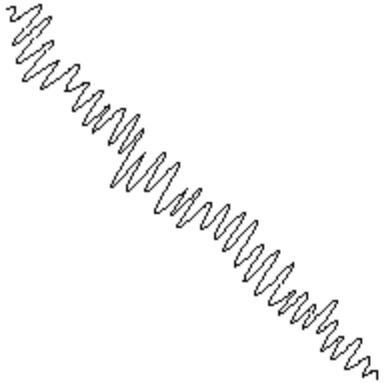
Strokes

Represented as curves

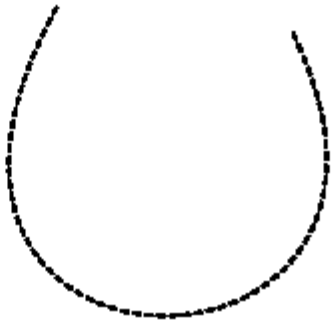


Multiresolution curves

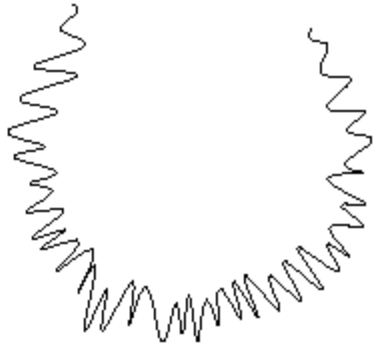
Base curve



Source curve



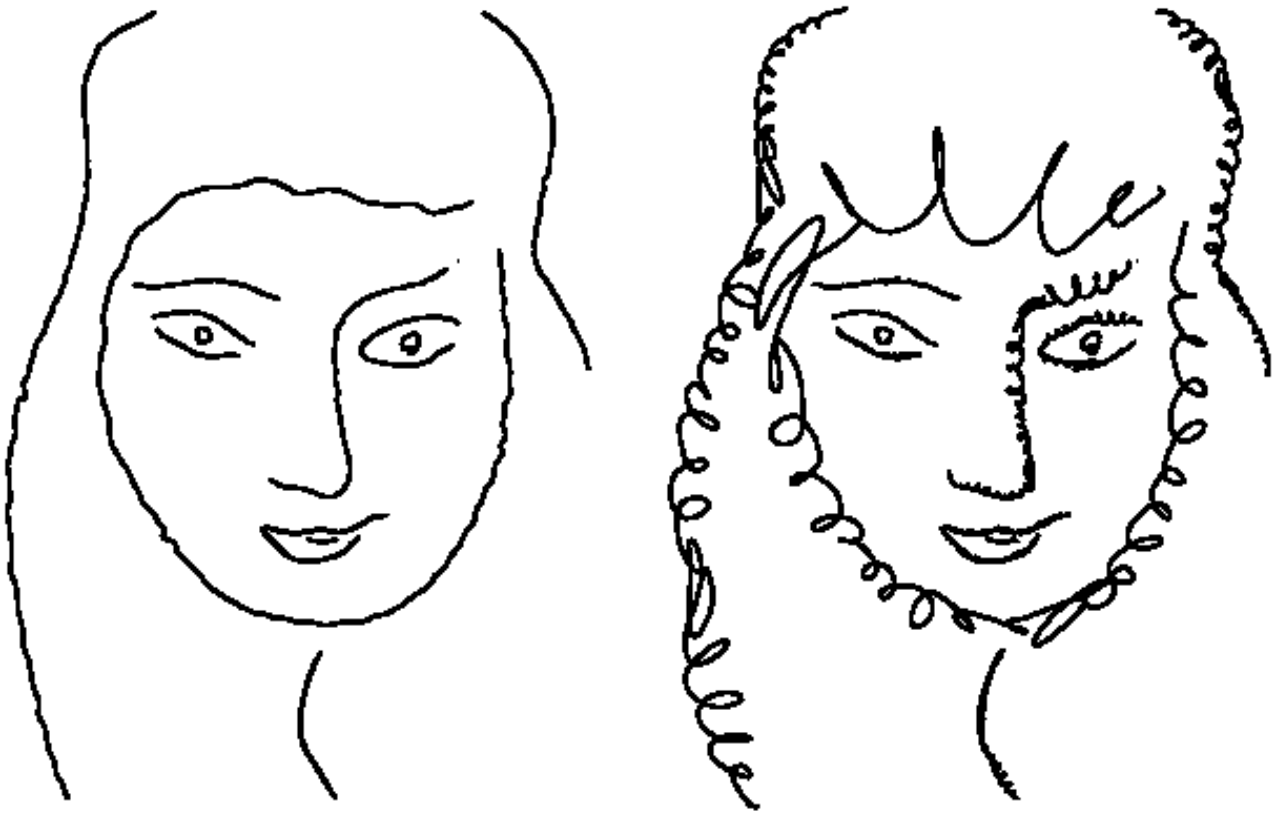
New base



Output

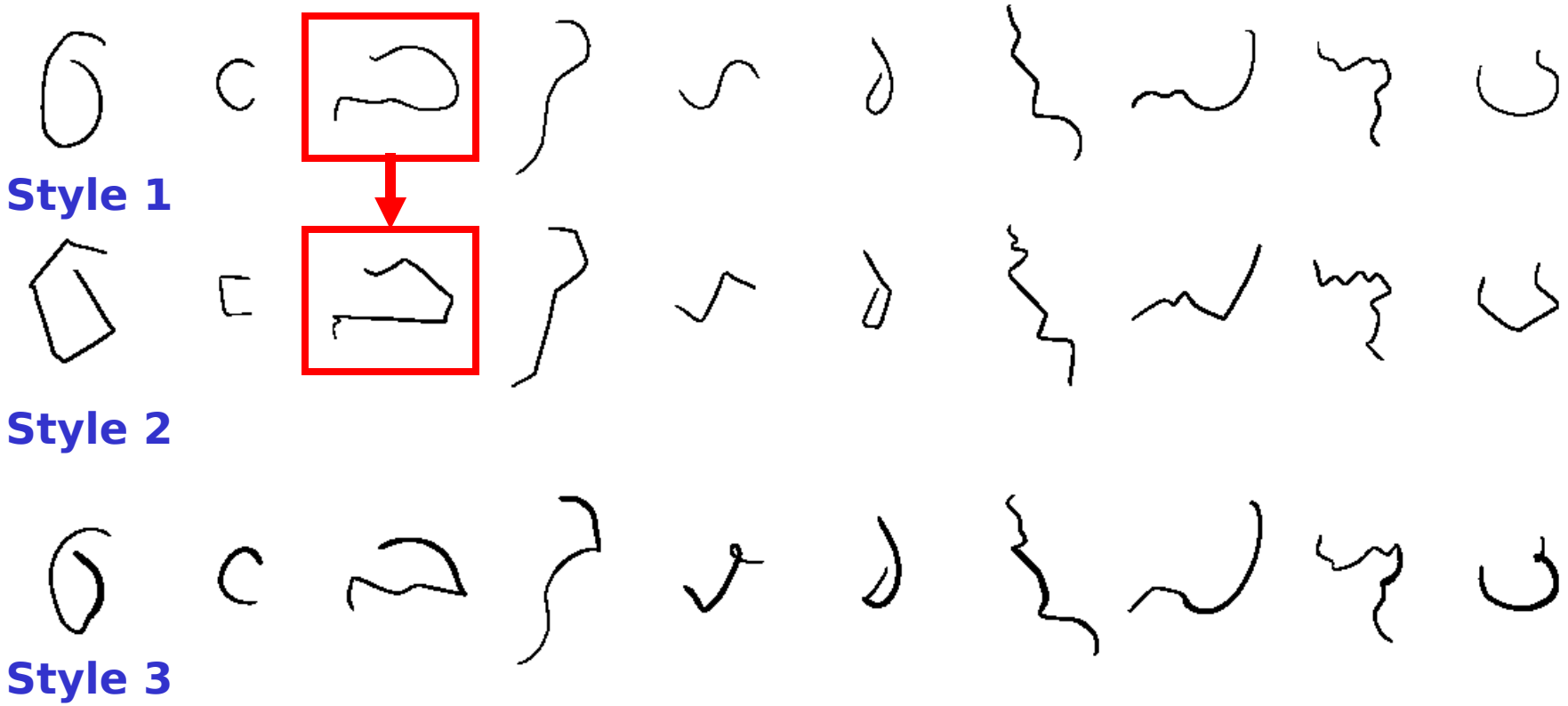
Finkelstein and Salesin, SIGGRAPH 94

Multiresolution curves



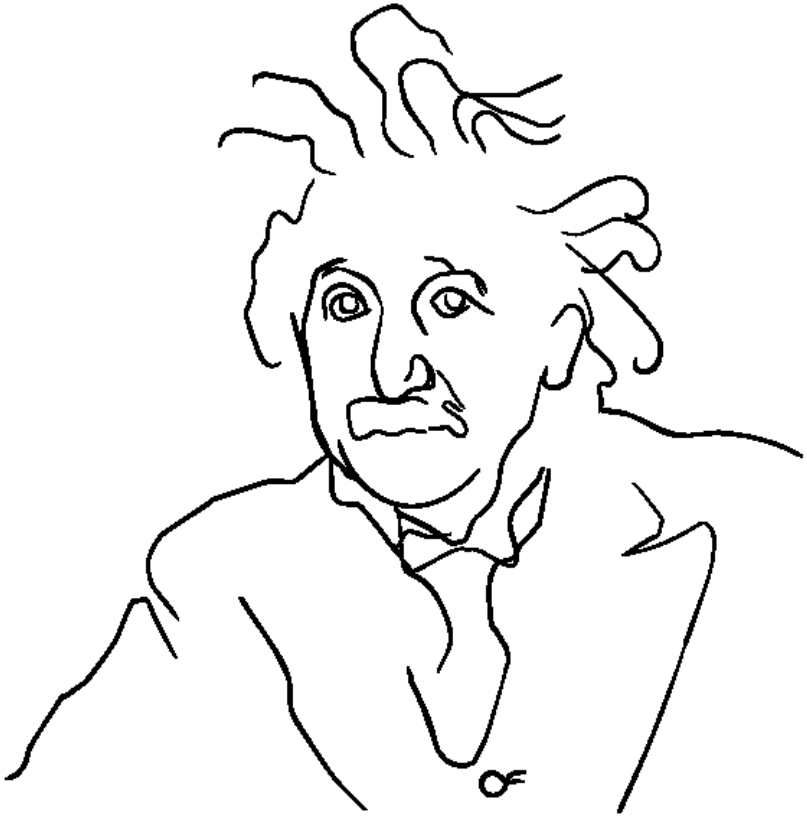
Finkelstein and Salesin, SIGGRAPH 94

Style transfer for line drawings



Freeman et al, MERL Tech report 99-11

Style transfer for line drawings

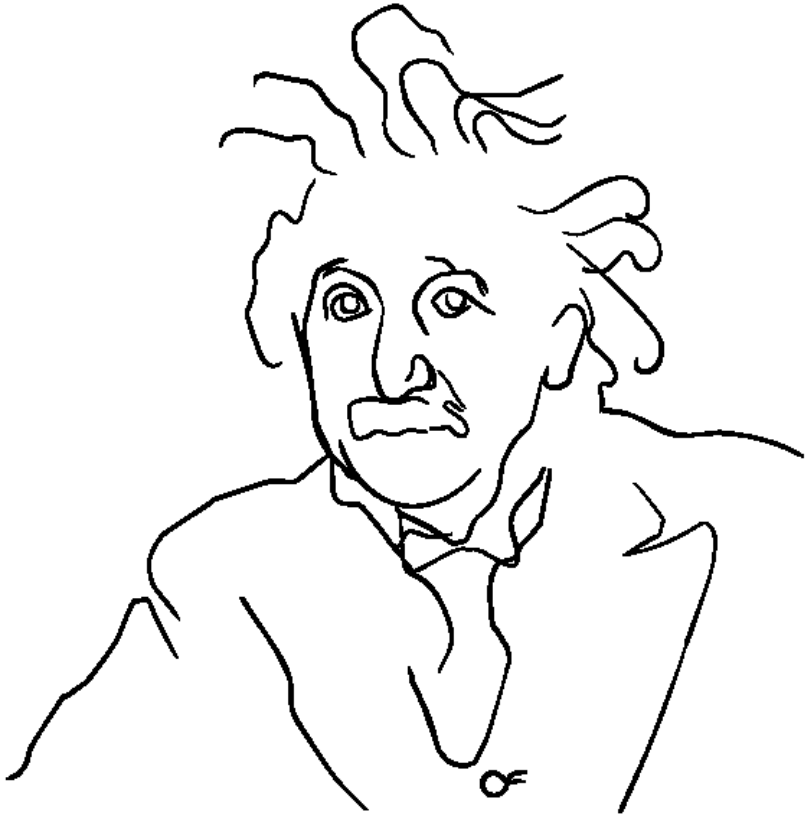


Input drawing

Output drawing

Freeman et al, MERL Tech report 99-11

Style transfer for line drawings

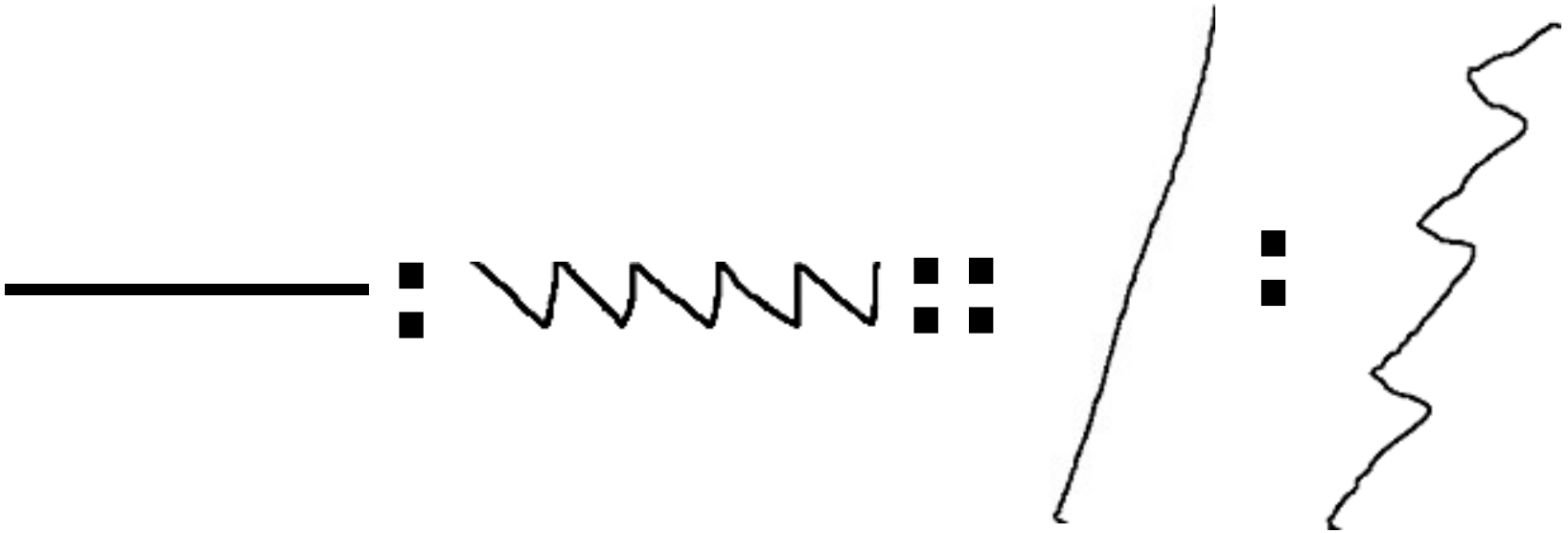


Input drawing

Output drawing

Freeman et al, MERL Tech report 99-11

Curve analogies



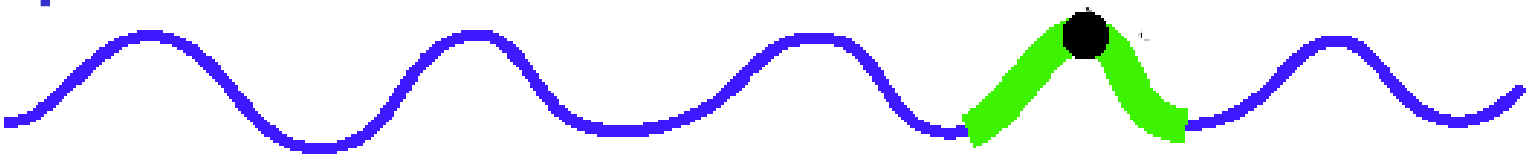
A A’ B B’

Hertzmann et al, EGWR 02; sketch tomorrow

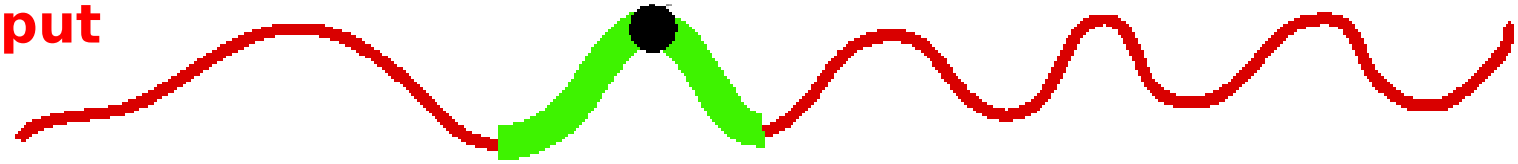
Curve texture synthesis

Problem statement

Example



Output



Hertzmann et al, EGWR 02

Curve texture synthesis

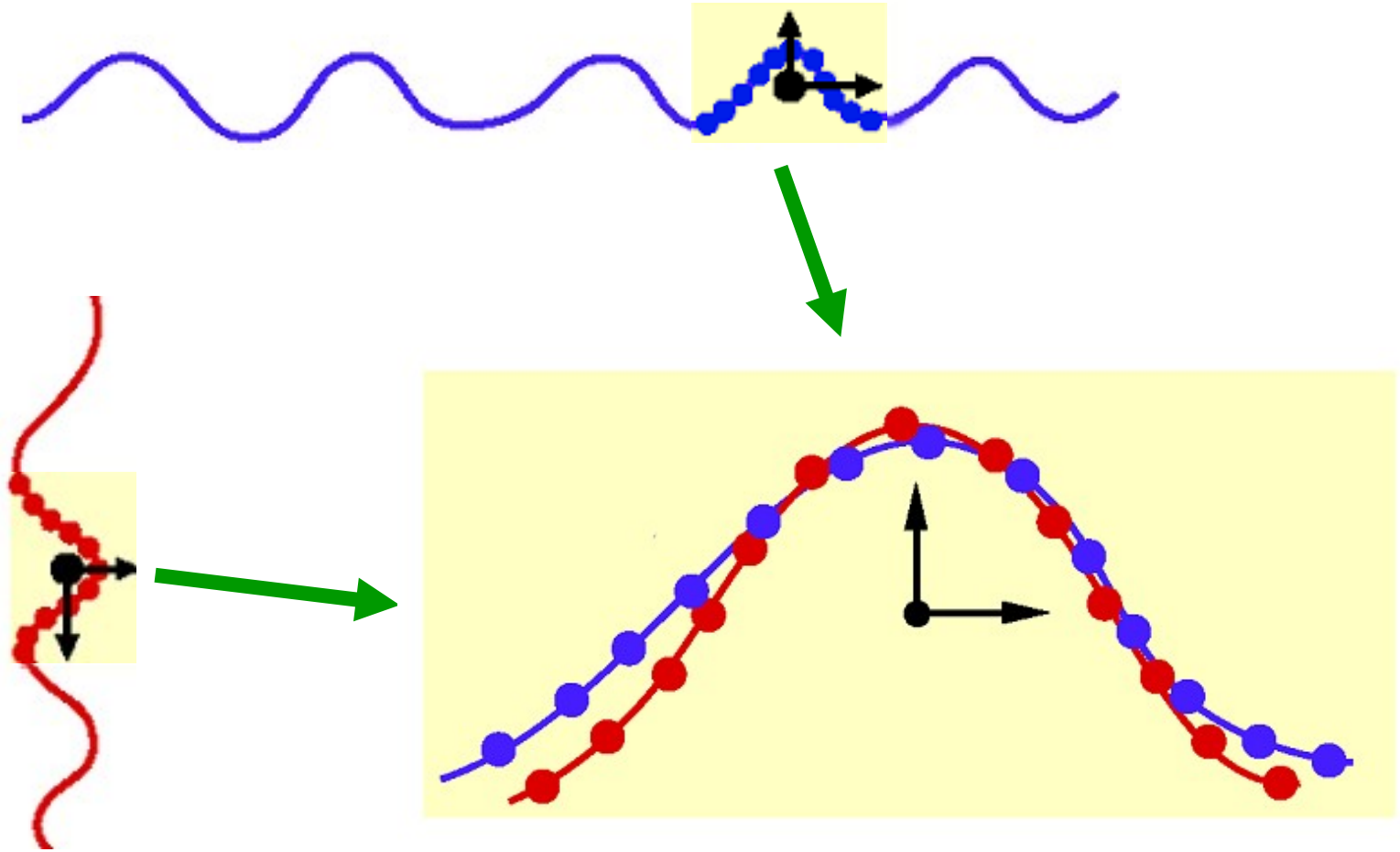
Problem statement

Example

Output

Hertzmann et al, EGWR 02

Neighborhood comparison

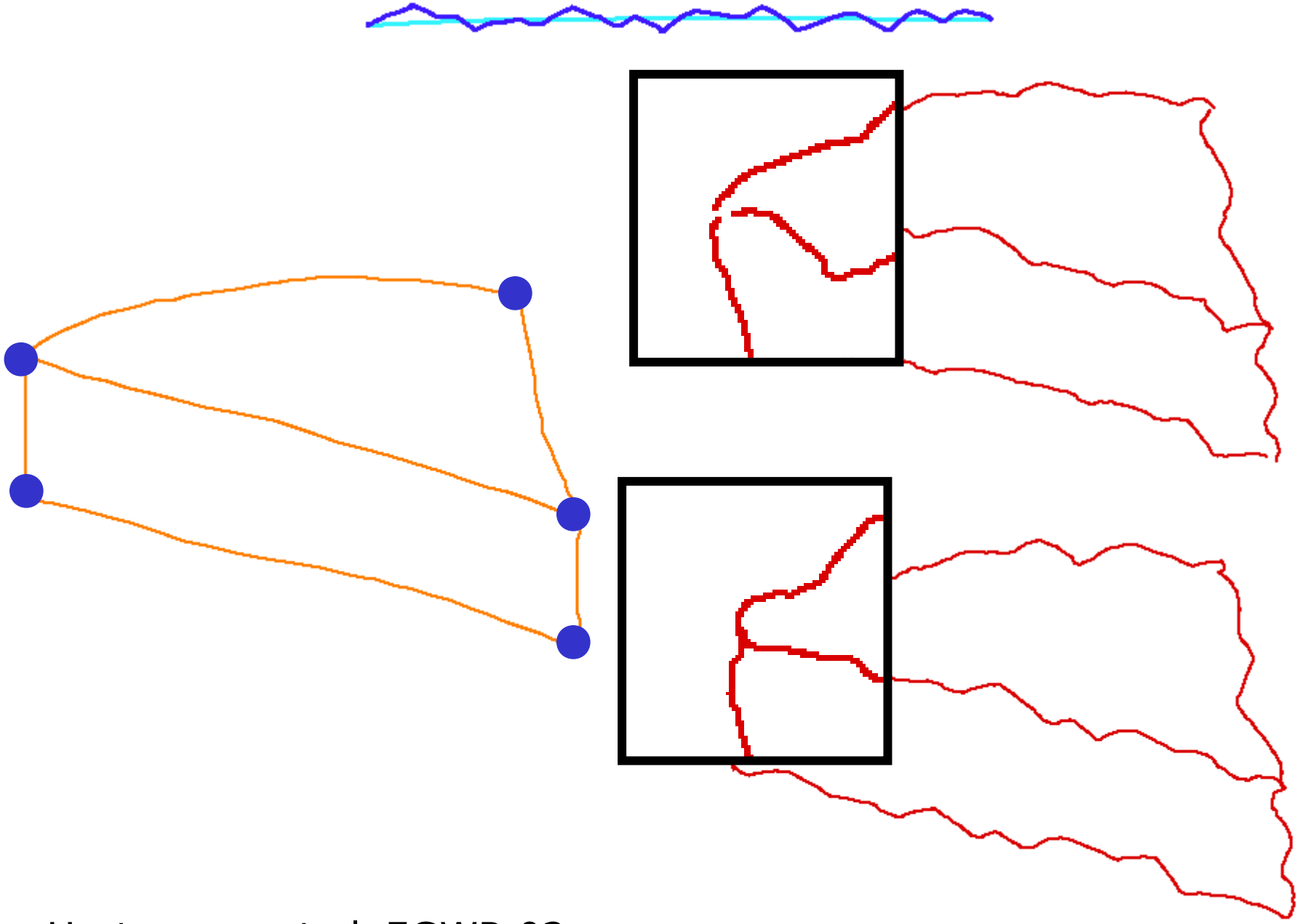


Results

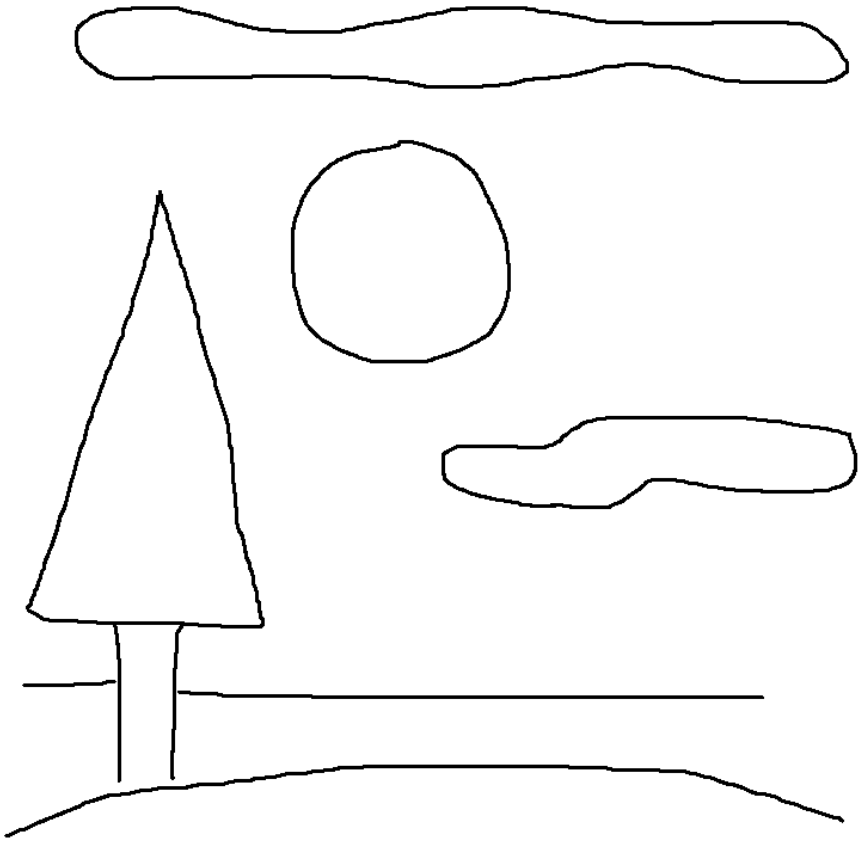
Input shape

Output shape

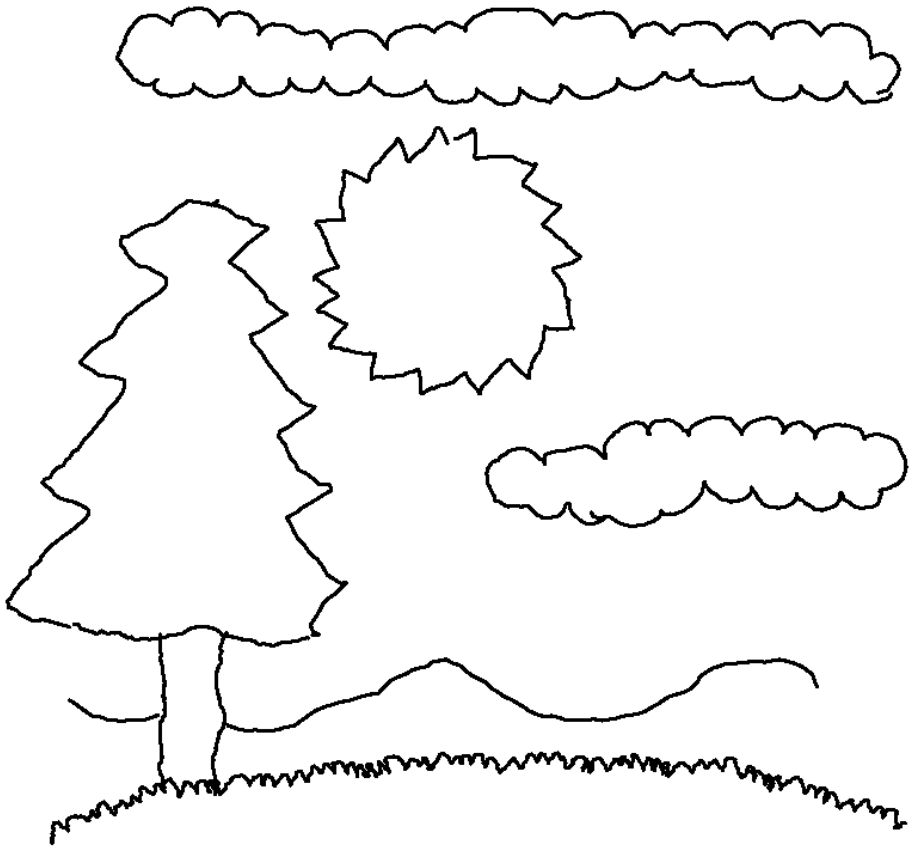
Hertzmann et al, EGWR 02



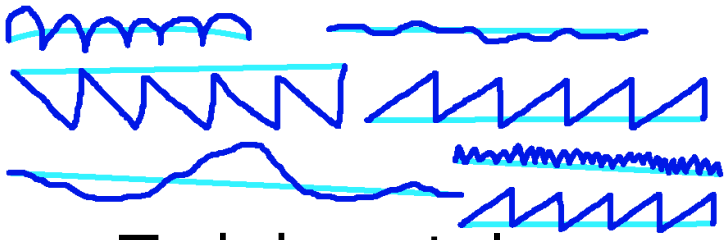
Hertzmann et al, EGWR 02



Input strokes



Output drawing



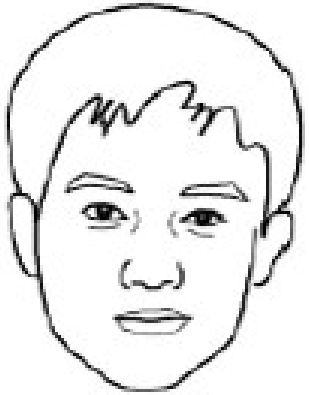
Training styles

Facial portraiture

A

A´

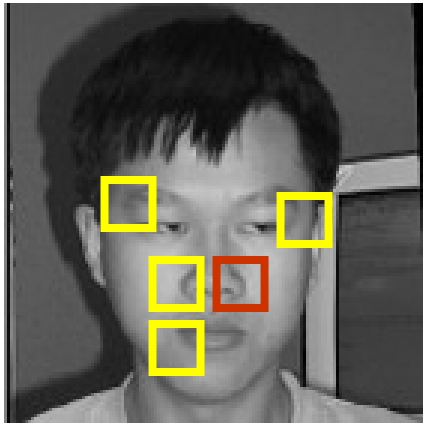
B

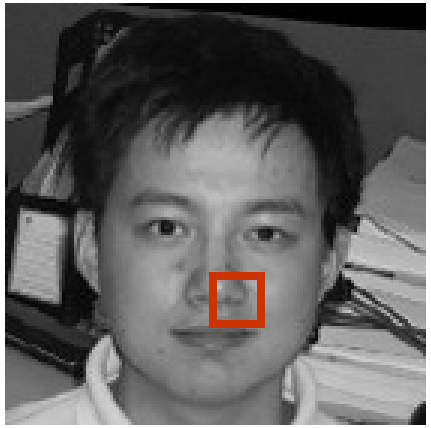


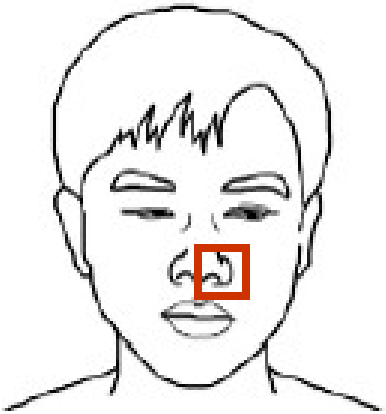
B

Chen et al., ICCV 01

Facial portraiture

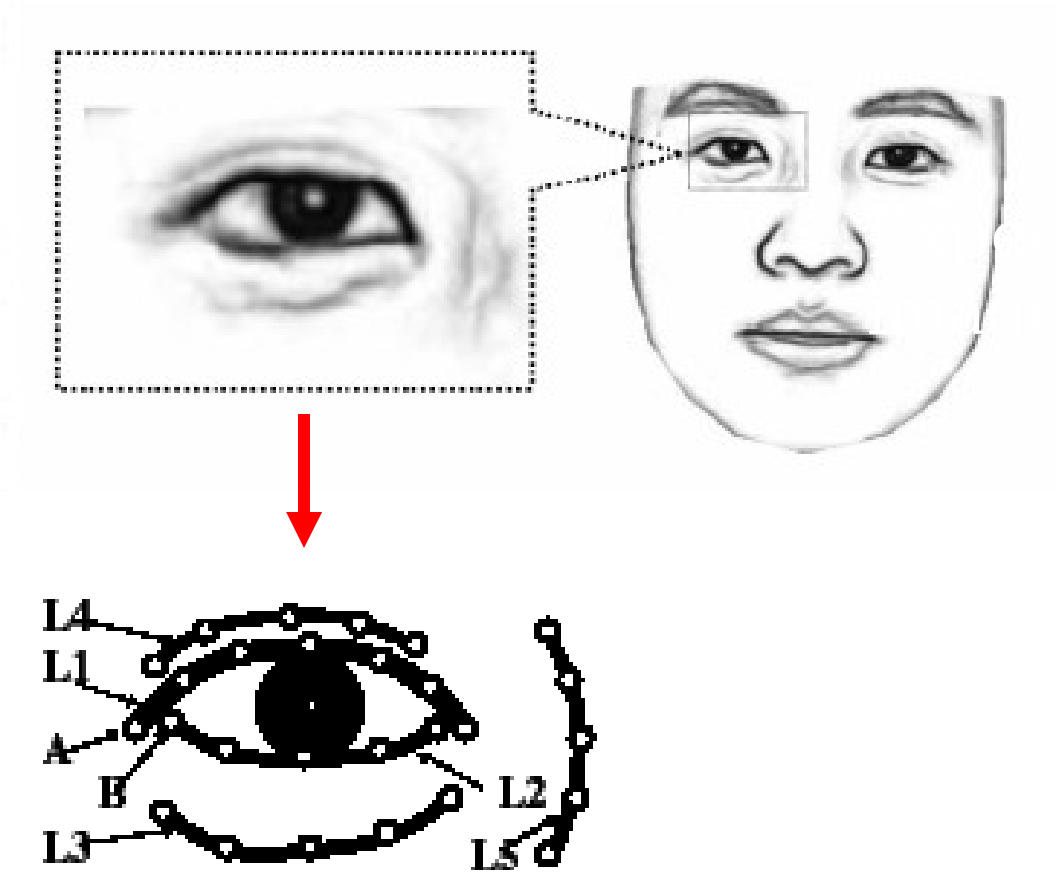






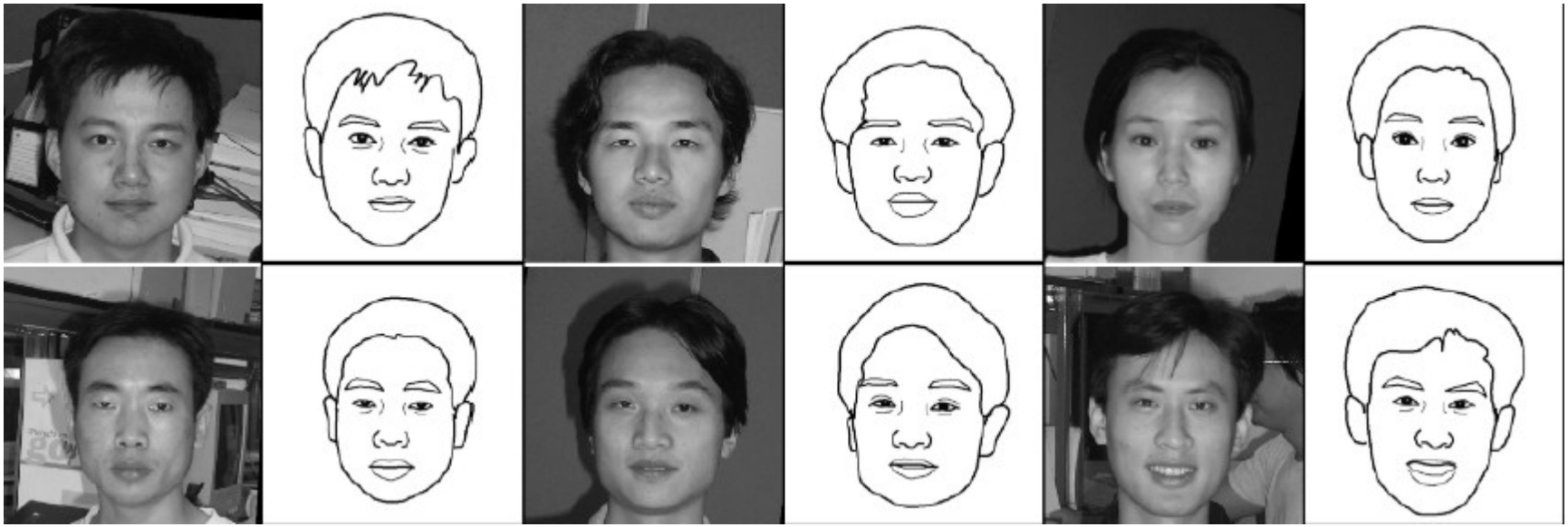
Chen et al., ICCV 01

Sketch model



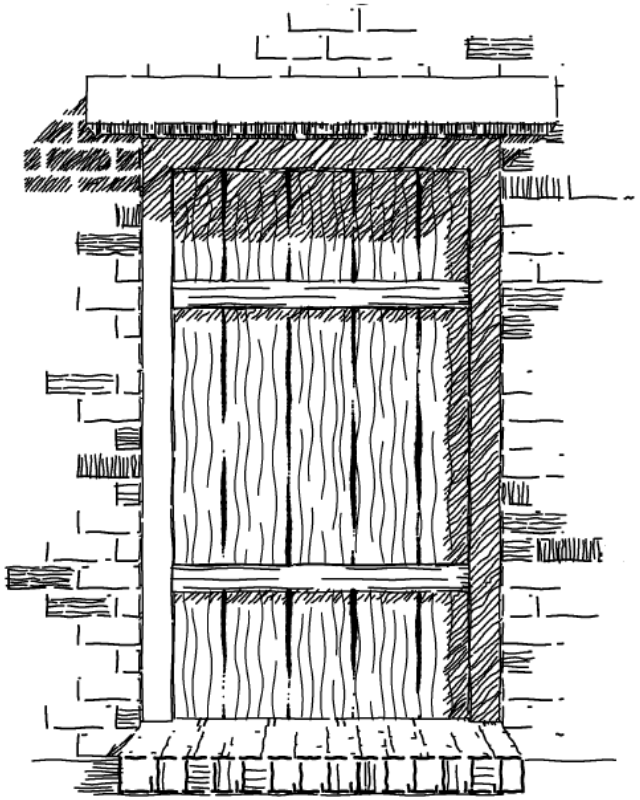
Chen et al., ICCV 01

Results

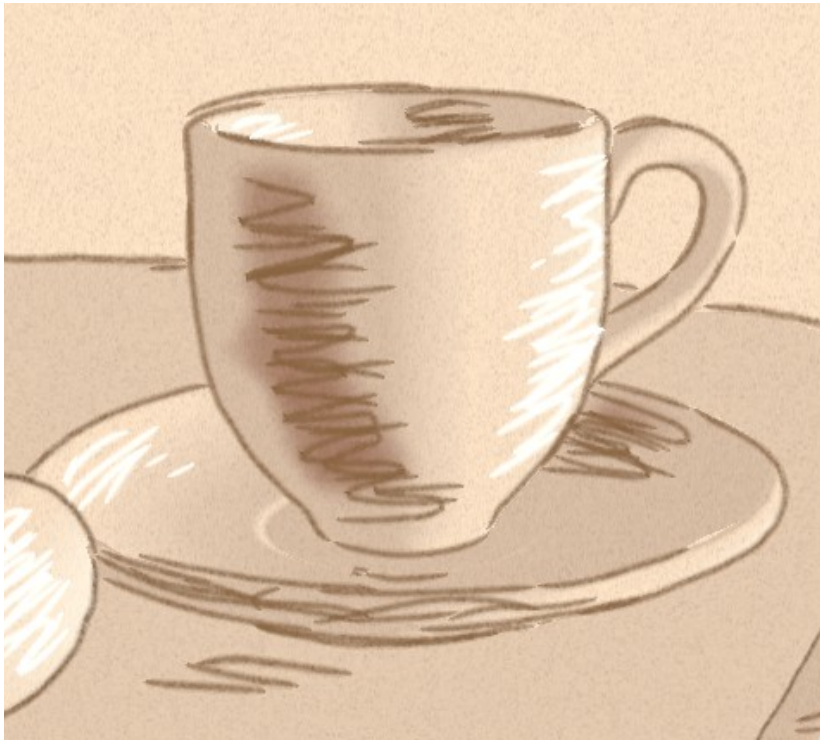


Chen et al., ICCV 01

Other EBNPR work



Salisbury et al,
SIGGRAPH 94, 96, 97

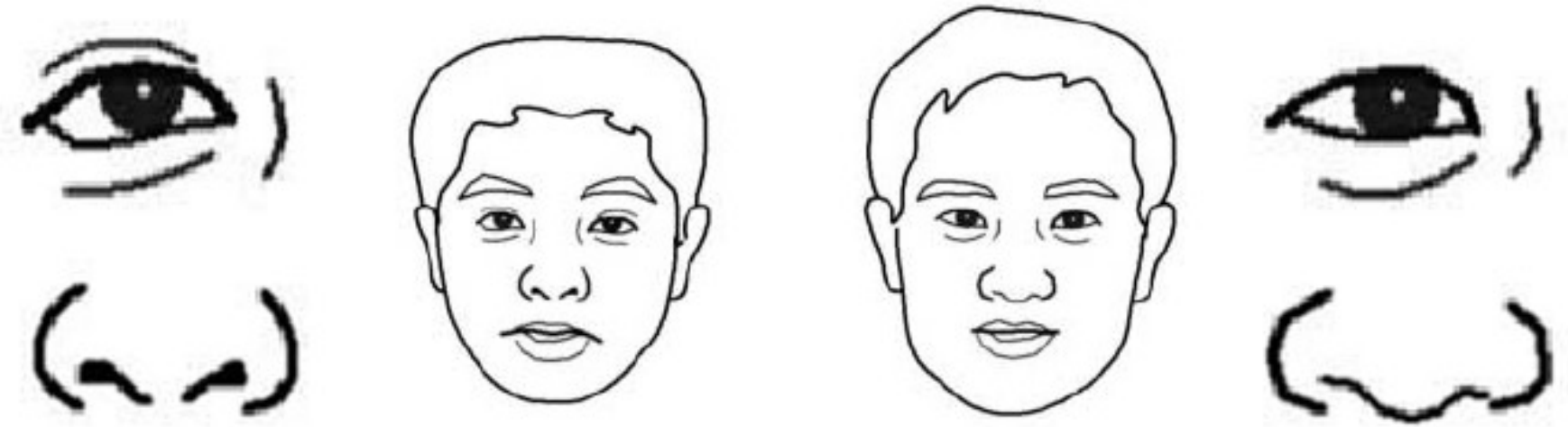


Kalnins et al
SIGGRAPH 02 (Friday)

Summary

- Example-based NPR
- Image texture synthesis
- Example-based image processing
- Example-based curve processing

Results



Chen et al., ICCV 01